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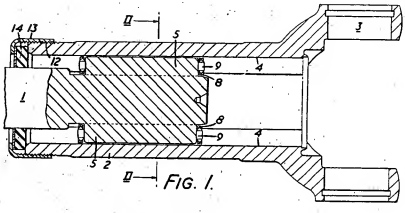

FIG. 1.

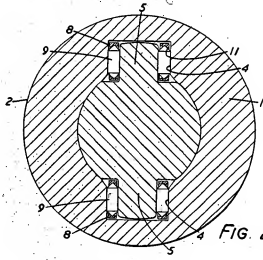

FIG. 2.

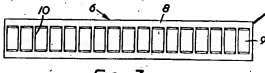

FIG. 3.

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49, 219/59.

PATENT SPECIFICATION

Complete Specification Lodged ..... 27th May, 1959. AUSTRALIA

Application Lodged (No. 49, 219/59) ..... 27th May, 1959. DIV. 340

Applicant ..... Birfield Engineering Limited. 21308

Actual Inventor ..... Edward John Rabson.

Convention Application.
(Great Britain, 27th May, 1958).

ABANDONED BEFORE ACCEPTANCE.

Complete Specification Published ..... 3rd December, 1959.

Classification 62.8; 60.8.

International Classification F 06 c.

Drawing attached.

COMPLETE SPECIFICATION.

"IMPROVEMENTS IN OR RELATING TO SLIDING JOINTS FOR POWER TRANSMISSION SHAFTS."

The following statement is a full description of this invention, including the best method of performing it known to us :-

This invention relates to sliding joints for use in power transmission shafts of the kind comprising a first shaft portion having a spline projecting therefrom and a second shaft portion having a spline-way therein with which the spline mates in order to provide a driving connection with adjustability for length of the shaft while it is transmitting torque. An example of this kind of shaft is the propeller shaft of a mechanically propelled vehicle where the shaft provides a drive between sprung and unsprung components.

A serious disadvantage of the foregoing arrangement when a conventional spline and spline-way is used is that, under high torque loading, the end loading necessary to adjust the shaft length is high because of the friction between the spline and spline-way. This can produce severe end loading of the adjacent

mechanism to which the shaft is attached and the object of the invention is to provide an improved sliding joint for use in power transmission shafts of the foregoing kind which will result in a reduction of the end loading of the shaft by reducing the coefficient of friction between the spline and spline-way.

According to the invention a new or improved sliding joint for power transmission shafts of the foregoing kind is provided wherein the spline has mounted thereon a caged roller bearing which extends in the form of an elongated endless belt along each side of the spline and round the ends of the latter with the rollers engaging between the spline and the spline-way. Thereby the sliding friction of the conventional arrangement is replaced by rolling friction and the foregoing object achieved. The bearing cage is preferably formed from a flexible or semi-flexible material, such as a suitable plastic, in order to enable the cage to travel with the rollers during sliding of the joint, the ends of the spline being radiused for this purpose.

Preferably the said first shaft portion has a plurality of splines projecting therefrom, each spline being provided with a caged roller bearing between it and its spline-way. For example there may be two such splines and spline-ways disposed in diametrically opposed relation to each other with respect to the axis of the shaft. Usually, although not necessarily, the spline or splines will be formed upon a male shaft portion projecting into and slidable within a female shaft portion in which the spline-way or spline-ways are formed.

The bearing cage is preferably constructed and/or arranged so that it forms neither the inner nor the outer race of the roller bearing which are formed respectively by the spline and spline-way. Moreover the slots formed in the bearing cage for the reception of the rollers are suitably shaped so that the latter are still retained despite alteration of the radius of curvature of a given portion of the cage during sliding of the joint. The arrangement is preferably such that the slots are larger at the inside of the cage than at the outside, the rollers placed in the cage from the inside being thereby prevented from passing right through to the outside of the cage, and the ends of the rollers may seat in recesses formed in the cage.

In order to assemble the joint the needles are first placed in the cage whereafter the filled cage is mounted on the spline, the shaft portion on which the spline is formed being then

slid into engagement with the shaft portion having the mating spline-way formed therein. As the joint slides, the rollers between the driving and driven shaft portions of the joint roll cause the cage to travel. Thus, both the rollers and the cage circulate around the spline under sliding movement of the joint, loaded rollers of the bearing being moved round to the opposite side of the endless roller track where they are unloaded while previously unloaded rollers move into place at the end of the driving side to take the load.

The invention will now be further described with reference to the accompanying drawings which illustrate, by way of example, a sliding joint representing one embodiment of the invention, and in which:-

Figure 1 is a side view of the joint mainly in cross-section,

Figure 2 is a cross-sectional view on the line II - II in Figure 1 to a larger scale, and

Figure 3 is a side view of a caged roller bearing of the joint to the same scale as Figure 2.

A first or splined shaft portion of the joint is a male member 1 provided by the forward end of a motor vehicle propeller shaft, slidably received in a second shaft portion 2 provided by the hollow boss of tubular projection of the rear-ward yoke member 3 of the front universal joint of the propeller shaft, the arrangement providing a sliding joint between the universal joint and the propeller shaft.

The tubular projection 2 has two diametrically opposed spline-ways 4 formed in its bore from end to end, and two diametrically oppositely projecting splines 5 on the end of the shaft portion slide in the spline-ways 4 each with the interposition of a caged needle roller bearing 6, shown more particularly in Figure 3. The cage 7 of each needle bearing 6 is in the form of an endless belt 8 of plastic material which extends around the corresponding spline 5 and by which a set of needle rollers such as 9 is carried.

The needle rollers 9 are conical at their ends and the cage 8 is so formed that the roller-receiving slots such as 10 therein are of greater dimensions at the inside of the cage than at the outside in a direction axially of the rollers, and are formed at their ends with conical recesses, such as shown at 11 in Figure 2, in which are seated the conical ends of the

corresponding rollers 9. Thereby the rollers 9 may only be sprung into position within the slots 10 from inside the cage and are retained therein by the flexibility of the cage 8 to form the caged needle bearing 6. They cannot leave their slots 10 to pass to the outside of the cage even under deflection of the latter, but nevertheless are so retained with the cage 8 mounted in position on the corresponding spline 5 that the rollers 9 project both outwardly and inwardly of the cage 8 in order to ensure that the latter travels with the rollers 9. To facilitate this travelling of the needle roller bearing 6 under sliding movement of the joint the ends of the splines 5 are radiused to form a smooth track without corners.

The rearward or free end of the tubular projection 2 of the yoke member 3 is threaded at 12 to receive a screwed ferrule 13 whereby an annular sealing plate 14 closely embracing the shaft portion 1 is clamped in position between the flange of the ferrule 13 and the end of the tubular projection 2 in order to prevent entry of foreign matter to the joint and the escape of lubricant therefrom.

The claims defining the invention are as follows :-

1. A new or improved sliding joint for power transmission shafts of the kind set forth, wherein the spline has mounted thereon a caged roller bearing which extends in the form of an elongated endless belt along each side of the spline and round the ends of the latter with the rollers engaging between the spline and the spline-way. (27th May, 1958).

2. A sliding joint according to claim 1, wherein the bearing cage is formed from a flexible or semi-flexible material, such as a suitable plastic, to enable the cage to travel with the rollers during sliding of the joint and the ends of the spline are radiused for this purpose. (27th May, 1958).

3. A sliding joint according to either of the preceding claims, wherein said first shaft portion has a plurality of projecting splines each of which is provided with a caged roller bearing between it and its spline-way. (27th May, 1958).

4. A sliding joint according to claim 3, wherein said first shaft portion has two splines disposed in

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diametrically opposed relation to each other with respect to the axis of the shaft. (27th May, 1958).

5. A sliding joint according to any of the preceding claims, wherein the spline or splines are formed upon a male shaft portion projecting into and slidably within a female shaft portion in which the spline-way or spline-ways are formed. (27th May, 1958).

6. A sliding joint according to any of the preceding claims, wherein the or each bearing cage forms neither the inner nor the outer race of the roller bearing which are formed respectively by the corresponding spline and spline-way. (27th May, 1958).

7. A sliding joint according to claim 6, wherein slots formed in the bearing cage for the reception of the rollers are suitably shaped so that the latter are still retained despite alteration of the radius of curvature of a given portion of the cage during sliding of the joint. (27th May, 1958).

8. A sliding joint according to claim 7, wherein the slots are larger at the inside of the cage than at the outside. (27th May, 1958).

9. A sliding joint according to claim 7 or 8, wherein end portions of each roller seat in depressions formed at the ends of the slots in the cage. (27th May, 1958).

10. A sliding joint according to claim 9, wherein the rollers have conical ends which seat in conical recesses in the cage. (27th May, 1958).

11. A sliding joint according to any of the preceding claims, wherein said first shaft portion is provided by a shaft portion of a motor vehicle propeller shaft. (27th May, 1958).

12. A sliding joint according to claim 11, wherein said second shaft portion is formed integrally with one yoke member of a universal joint. (27th May, 1958).

13. A sliding joint according to claims 5 and 12, wherein said second shaft portion is a tubular projection of the yoke member. (27th May, 1958).

14. A sliding joint according to claim 13, wherein the free end of said tubular projection is threaded to receive a screwed ferrule retaining an annular sealing plate closely embracing said first shaft portion. (27th May, 1958).

15. A sliding joint constructed and arranged substantially as herein described with reference to the accompanying drawings. (27th May, 1959).

16. A motor vehicle propeller shaft embodying a sliding joint constructed and arranged substantially as herein described with reference to the accompanying drawings. (27th May, 1959).

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Patent Attorneys for Applicant.

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Serial No.	Application No.	Classification.
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Printed for the Government of the Commonwealth by
A. J. Arthur, Commonwealth Government Printer, Canberra.